Tone Shift and Tone Spread in siSwati: An Alignment Approach

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ABSTRACT

Mobility of High (H) tone is one of the fundamental phenomena of Bantu tonology (Kisseberth & Odden 2003: 62). H tone shift and H tone spread are instances of such mobility. This paper discusses tonal behaviour in siSwati (S.43) within the framework of Optimality Theory. In siSwati, H tone moves rightwards, to the penult in phrase-medial forms and to the antepenult in phrase-final forms. The generalisation that tone moves rightwards is accounted for by an alignment constraint, ALIGN-R, which requires that H tone be aligned with the right edge of the word. To account for the extratonality of the final syllable(s) I use the constraint NONFINALITY. However, monosyllabic and disyllabic roots behave differently from polysyllabic roots because they realise tone on the final syllable. Since movement is only rightwards, leftward movement is blocked by the constraint ANCHOR-L which requires that the left edge of the tone in the output should correspond to a left edge in the input.

Keywords: Bantu, siSwati, tone shift, tone spread, alignment, optimality.

1. INTRODUCTION

Like most Bantu languages, siSwati is a tone language that uses variations in fundamental frequency in order to convey lexical and grammatical meaning. SiSwati has a surface two-tone system. However, it has been suggested and argued in the literature that, although phonetically there is High (H) vs. Low (L) tone, phonologically the tonal contrast in Bantu Languages is H vs. toneless (Downing 1990, Myers 1997, Creissels 1999, Hyman 2000, Cassimjee & Kisseberth 2001, Yip 2002). The L tone is added at the end of the phonological derivation to supply any syllable that is still toneless with a tonal specification. This suggestion is supported by the fact that tonological patterns in Bantu languages depend on H tones, not L tones. For example, tone spreading, tone shift, plateauing, and tone reduction affect H tones not L tones (Hyman 2000). Myers (1997) observes that when two H tones are juxtaposed, there is generally some effect or adjustment, but nothing happens when two L-toned syllables are juxtaposed. He further observes that the position of H tone is restricted: it may not occur word-finally, for example, whereas L tone can occur in any position in a word.

Bradshaw (2003), in her discussion of the interaction between tone and consonants in siSwati, argues that siSwati can be analysed as a three-tone

language: H, Mid (M), and L. She argues that the language has both H tone and L tone underlyingly. The default tone, according to her, is actually M and not L, as has been previously claimed (see Section 3 for a further discussion of Bradshaw's arguments). For the purposes of this paper, I will follow the scholars that assume a H toned vs. toneless opposition. This approach is preferred because it makes it possible to capture the generalisations about the behaviour of lexical tone in the language. The terms 'tone shift' and 'tone spread' therefore refer to the movement of H tone. The underlyingly toneless words are referred to as L-toned. The main objective of this paper is to provide an Optimality Theoretic analysis of tone shift and tone spread in siSwati verbs. It is not the intent to discuss the general behaviour of tone in the language; therefore, a discussion of depressor consonants, contour tones, and the floating grammatical tone will not be included.

Bantu languages have agglutinative morphology, that is, different types of morphemes concatenate with the verb or nominal stem to form a word. These morphemes may either be H-toned or L-toned. Mobility of H tone is one of the fundamental phenomena of Bantu tonology (Kisseberth & Odden 2003: 62). H tone shift and H tone spread are instances of such mobility. A tone may originate from any of the morphemes and either shift or spread to the right of where it originated from, either to the penultimate or the antepenultimate syllable. This is the general pattern in Nguni languages. In some languages, though, one may find leftward movement, but it is less common. Examples include Shi and Tonga (Philippson 2006). Leftward shift may be used in some languages only as a strategy to avoid H tone on the final syllable (Kisseberth & Odden 2003, Downing (1990, 2001), among others. While other analyses are rule-based, Cassimjee (1998), Cassimjee & Kisseberth (1998) and Downing (1990) use the Optimal Domains Theory (ODT).

In this paper I use a more standard OT approach, Correspondence Theory. I also relate the behaviour of tone to the behaviour of palatalisation in the passive, a process which also occurs in siSwati. I argue that the long-distance effects observed in both the passive and in tonal behaviour result from a general family of constraints, in particular alignment constraints. The passive morpheme *-w-* always aligns with the right edge of the root /sit-w-a/ > [sitʷ-a] 'be helped'.[1] The proposal is that tone follows the same principle; it aims to align with the rightmost syllable of the word.

The rest of the paper is organised as follows: Section 2 briefly discusses the morphological domains that are relevant to the analysis of tone in siSwati. Section 3 presents sources of both L and H tone in siSwati. A discussion of H-toned verbs is presented in Section 4. Section 5 presents a new alignment approach where I show that Align-R is responsible for the movement of tone

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[1]   When the verb stem contains a labial, an additional floating [Cor] feature docks onto this labial, producing palatalisation: /ɓopʰ-w-a/ > [ɓoʃʷ-a] 'be tied up', /kʰumul-w-a/ > [kʰuɲulʷ-a] 'be undressed'. Note that the feature [Cor] docks onto the rightmost labial in the verb root. For a detailed analysis of palatalisation in the passive, see Malambe (2004, 2010).

towards the right edge of the PrWd in siSwati. Finally, I summarise the paper in Section 6.

2. MORPHOLOGICAL DOMAINS

This paper discusses tonal behaviour as observed in verbs. I have mentioned that in Bantu languages morphemes concatenate to form a verb. This fact is important in the understanding of tonal phonology in Bantu languages. Tone that is underlyingly associated with one morpheme may surface on a different morpheme. Morphological domains may contribute to the surface realisation of tone. A review of these domains is therefore in order.

For purposes of phonological analysis, the Bantu verb consists of different morphological domains. According to Hyman and Ngunga (1994) and Myers (1997), for the purposes of tonological analysis the verb in Bantu languages can be seen as consisting of two overlapping domains, namely the Macrostem (MStem) and the Phonological Word (PhWd): the MStem is the part that consists of the verb root plus suffixes and in addition the object marker.[2] The PhWd includes the MStem plus morphemes before the object marker, for example, [[ɓa-ya[si-fundz-el-a]$_{MStem}$]$_{PhWd}$ 'they read for us'. Myers (1987) further groups the morphemes that precede the MStem under what he refers to as an Inflectional Stem (tense, aspect and modality). A combination of morphemes from the two stems comprises a PhWd; this is the term I adopt in this paper. For example in his analysis of tone in Shona, Myers (1997) observes that the domain of Meeussen's Rule is the PhWd while that of fusion is either the Inflectional Stem or the MStem. In the following analysis I show that the differences in tonal behaviour of the siSwati verb are also influenced by the morphological domain of the underlying tone: namely, the MStem and the PhWd.

3. SOURCES OF TONE

In siSwati, verbs are either H-toned or toneless. However, Bradshaw (2003) argues for a three-way tone system in siSwati and therefore includes M tones in the surface representation of words; for example, in /u-ya-bon-a/, the tone melody would be MMHM. The default tone, according to her, is actually M and not L, as has been previously claimed. Bradshaw bases her argument on the fact that siSwati has depressor consonants and also that certain grammatical morphemes are L-toned underlyingly. Depressor consonants are the voiced consonants which lower neighbouring H tones, and may also block H spreading

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2   I am grateful to an anonymous reviewer for pointing out that, in Myers (1987, 1997), certain Shona subject and tense morphemes may also form part of the macrostem.

across them. Bradshaw argues that the reason why these consonants block tone is because they have their own tone underlyingly. However, according to Traill, Khumalo and Fridjohn (1987), it is inappropriate to classify depressor consonants as having L tone since they have an effect on both H and L tone. Their argument is based on an experiment which they conducted on isiZulu depressors. In that experiment they observed that the pitch-lowering effect of a depressor is so extreme that the pitch interval between a depressed tone (H or L) and L is greater than the interval between non-depressed L and H. This led them to conclude that a depressed tone is not L tone. However, Traill (1990), in his experimental study of depressor consonants on siSwati tone, acknowledges that there might be a third tone in the language, albeit with a limited distribution. Nevertheless, for the purposes of this paper I assume the H vs. L tone analysis. Sources of H tone in siSwati are any of the following affixes: the 3rd person subject markers, infinitive *ku-*, all object markers, and H tone verb roots. Examples are presented in (1). In the following list of affixes, subject markers and object markers are presented in singular/plural forms, for example class 1/2; 1 indicates the singular while 2 marks the plural counterpart.

(1) **L-toned affixes**

Subject marker: 1st person: ngi-/si-
2nd person: u-/ni-
Progressive marker: -ya-
Future tense marker: -to-, -tawu-
Verbal extensions: -is, -el, -an
-ek, -isis, -w

H-toned affixes

Subject marker: All 3rd person:
e.g. class 1/2: u-/ɓa-
class 7/8: si-/t'i-
Object marker: All classes
e.g. class 1/2: -mu-/-ɓa-
class 9/10: -yi-/-ti-
Infinitive: ku-

H-toned verbs have the underlying H tone on the first syllable of the verb root. The input H tone targets either the penultimate syllable if the verb is in phrase-medial position or the antepenultimate syllable if the verb is phrase-final. The data that I present combines different types of morphemes, both H-toned and L-toned. The data is adapted from Creissels (1999), and verified by an experimental study that I undertook on the behaviour of tone in siSwati (see Malambe (2006) for details and analysis of the study). This study confirms Creissels' conclusions regarding the surface position of tone in siSwati. Figure 1 shows the difference between the position of tone phrase-finally and phrase-medially. Before I present the graph, I discuss three terms that need to be distinguished in the discussion of tone: Fundamental Frequency (F_0), pitch and tone. F_0 is a purely phonetic, acoustic term referring to the signal itself, measured in Hertz (Hz). Pitch is a perceptual term, the hearer's perception of the signal. Tone on the other hand is a phonological term. The assumption is that F_0 is the primary cue for pitch, and therefore tone perception. However, according to Yip (2002), some scholars suggest that other factors such as amplitude, duration and voice quality contribute to tone differences. See Yip (2002) and

references cited therein for a detailed discussion of the relationship between tone and F_0. For the purposes of this paper I follow Yip (2002) in the assumption that F_0 is the primary cue for the discrimination of tones in natural languages. To facilitate comparison of phrase-final tone and phrase-medial tone, Figure 1 overlays the graphs of the following verbs:[3]
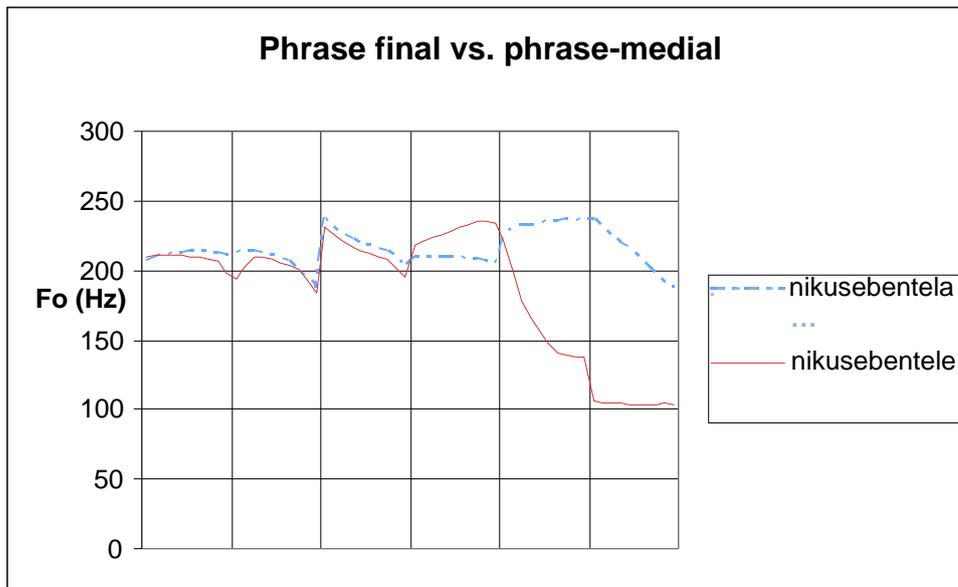
(2) ni   ku   se̲ bé nt e l   e
     SM2P   OM15   work   APPL   PST
     'you worked for it'

(3) ni   ku̲   se̲ be nt é l   a …
     SM2P   OM15   work   APPL   FV
     'you work for it …'

In these particular examples, (2) and (3), spaces indicate syllable boundaries. Also, as in all other examples that I present, underlining indicates the location of underlying H tone and an acute accent mark shows its surface placement. In Figure 1, each column on the X-axis represents a syllable while the rows on the Y-axis display F_0 in Hz. The phrase-final verb in (2) is represented by a solid line on the graph while the broken line represents the phrase-medial verb (3). The two words are segmentally identical (except for the final vowel). The difference in tone position between examples (2) and (3) is brought about by the difference in sentence position of the verbs, phrase-final versus phrase-medial.

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[3] Abbreviations used in the examples are as follows: SM: verbal subject morpheme, OM: verbal object morpheme, PROG: progressive morpheme, FUT: future tense morpheme, FV: final vowel, PST: past tense morpheme; the verbal extensions are abbreviated as follows: RECIP: reciprocal, CAUS: causative, APPL: applied, INTENS: intensive. Numbers in the glosses are noun class numbers except for 2P, which indicates 2nd person plural. Colons have been inserted in the examples to indicate lengthened vowels, but are not part of standard siSwati orthography. Morphemes are separated by hyphens, as are their meanings in the glosses.

Phrase final vs. phrase-medial

Figure 1. */ni ku̱ se̱ bé nte: le/: phrase-final form - tone is realised on the antepenultimate syllable. /ni ku̱ se̱ be nté la …/: phrase-medial form - tone is realised on the penultimate syllable.*

The F_0 contours in Figure 1 suggest that, in both words, the first three syllables are relatively low in pitch. We observe that when the word is phrase-final (solid line), the pitch goes up on the antepenult, then drops off sharply, but when it is phrase-medial (broken line), the pitch does not go up until the penult, and then it drops off. What appears as a rise on the onset of the third syllable is the perturbation of the fricative [s]. Notice that the pitch changes during the vocalic portion of the syllable. Compare this syllable with the penultimate on the solid line and the antepenult on the broken line, where the pitch rises and remains at an almost steady state. Fricatives have no formant structure, and thus detection of linguistically significant pitch on a fricative might be impaired. According to Zhang (2000), since the point of transition from onset to nucleus is a period of rapid transitions in formant frequencies, this might interfere with pitch perception, and thus be a poor position to realise linguistically significant pitch. This graph confirms the generalisation that the siSwati speaker captures the difference between phrase-final and phrase-medial position by realising H tone on different syllables: the antepenult phrase-finally, and the penult phrase-medially.

4. H-TONED VERBS

When any of the morphemes has H tone the output representation also surfaces with H tone. I first give examples where H tone is contributed by only one morpheme.

4.1 ONE H TONE IN THE INPUT

In phrase-final forms tone shifts rightwards to the antepenultimate syllable. However, words with H-toned monosyllabic and disyllabic roots behave differently, with the tone remaining in the underlying position, the initial syllable of the root. So as not to unnecessarily distract the reader, these forms will be presented later, in Section 4.5. In polysyllabic stems, tone shifts from the initial syllable to the antepenult and penult in phrase-final and phrase-medial forms respectively. In the following examples, the source of the H tone is underlined and its surface position is shown by the acute accent.

(4) Phrase-finally: Single H from root shifts to antepenult.

> L   L   H
> ni   ya   ɓ<u>u</u>lal-an-a   >   ni-ya-ɓ<u>u</u>lál-a:n-a   'you kill+recip'
> SM2P   PROG
>
> ɓ<u>u</u>lal-is-an-a > ni-ya-ɓ<u>u</u>lal-ís-a: n-a 'you kill+caus+recip'
> 'You (pl.) are V… '

The verbs in both (4) and (5) have their underlying tone on the initial syllable of the verb root. However, the H tone target may shift from the antepenultimate syllable to the penult, when the same word occurs in phrase-medial position.

(5) Phrase-medially: Single H shifts from root to penult.

> L   L   H
> ni   tawu   ɓ<u>u</u>lal-a   >   ni-tawu- ɓ<u>u</u>lál-a Sipho   'kill'
> SM2P   FUT
>
> ɓ<u>u</u>lal-is-a > ni-tawu- ɓ<u>u</u>lal-ís-a Sipho   'kill+caus'
> 'You (pl.) will V… Sipho'

In polysyllabic verbs the underlying position of the H tone does not make a difference to the surface position. It moves to the same location as before; the antepenultimate syllable phrase-finally, and the penult phrase-medially. In examples (6) and (7) the source of the H tone is the class 2 subject marker *ɓa-*.

(6) Phrase-finally: Single H from subject marker shifts to antepenult.

> H   L   L
> ɓ<u>a</u>   ya   ɫaɠul-a   >   ɓ<u>a</u>-ya-ɫá ɠu:l-a   'weed'
> SM2   PROG
>
> ɫaɠul-is-an-a > ɓ<u>a</u>-ya-ɫaɠul-ís-a:n-a   'weed+caus+recip'
> 'They are V…ing'

(7) Phrase-medially: A single H shifts from the subject marker to the penult.

H	L	L			
ɓa	to	natsʰ-is-a	>	ɓa -to-natsʰ-ís-a Sipho	'drink+caus.'
SM2	FUT				
		natsʰ-is-an-a	>	ɓa-to-natsʰ-is-án-a na Sipho	'drink+caus+recip'

'They will V… together'

In the next set of examples the source of H tone is the class 9 object marker *-yi-*. Object markers immediately precede the verb root. Note that the tone moves off the object marker onto the antepenult in phrase-final forms.

(8) Phrase-finally: A single H shifts from the object marker to the antepenult.

L	L	H	L		
ni	ya	yi	łaɠul-a	>	ni-ya-yi- łáɠu:l-a	'weed'
SM2P	PROG	OM9			
			łaɠul-is-is-a	>	ni-ya-yi-łaɠul-ís-i:s-a	'weed properly'

'You (pl.) are V… it'

Tone is realised on the penultimate syllable in all forms, phrase-medially.

(9) Phrase-medially: A single H shifts from the object marker to the penult.

L	H	L			
ni	yi	natsʰ-is-a	>	ni-yi-natsʰ-ís-a Sipho	'drink+caus'
SM2P	OM9				
		natsʰ-is-el-a	>	ni-yi-natsʰ-is-él-a Sipho	'drink+caus+appl'

'you (pl.) V… it together'

In the following sections I discuss the contribution of morphological domains to the surface realisation of tone. First, I discuss the behaviour of tone when it originates from within the macrostem (Section 4.2), and then, in Section 4.3 and Section 4.4, I discuss its behaviour when it originates from the PhWd.

4.2   TWO ADJACENT H TONES WITHIN THE MACROSTEM

In the following examples both H tones are from the MStem (the object marker *-yi-* and the verb root). The first tone gets deleted and the second one shifts according to the same principles as in the previous examples in (4) and (5), where there was only one H tone contributed by the verb root. In all the examples that follow, the left square bracket indicates the left edge of the MStem.

(10) Phrase-finally: One H deletes and the second shifts to the antepenult; however, if the tone originates from the antepenult it will move to the penult which is generally not the target phrase-finally.

L	L	H	H
ni	ya	yi̱	se̱ɓent-a	> ni-ya-[yi̱-se̱ɓé: nt-a	'work'
SM2P	PROG	OM9

| | | | se̱ɓentel-a | > ni-ya-[yi̱-se̱ɓénte:l-a | 'work+appl' |

'You (pl.) are V… it'

Just as in phrase-final position, phrase-medially, one tone gets deleted, and the remaining tone shifts to the penultimate syllable.

(11)   Phrase-medially: One H deletes and the second shifts to the penult.

L	H	H
ni	yi̱	se̱ɓent-a	> ni-[yi̱-se̱ɓént-a kanyekanye	'work'
SM2P	OM9

| | | pʰe̱keletel-a | > ni-[yi̱-pʰe̱keletél-a kanyekanye | 'accompany' |

'You (pl.) V… it together'

4.3   TWO NON-ADJACENT H TONES WITHIN THE PHWD

When tone is contributed by the PhWd we see a different pattern: the second tone spreads instead of shifting to the target positions as observed when the tone was solely contributed by the MStem. When two H tones are separated by an L tone, both survive. The initial tone shifts to the following syllable and then we see an H tone plateau up to the antepenult phrase-finally, and up to the penult phrase-medially due to spreading of the second H tone. In the following examples, the H-tone subject marker *a-* is used in conjunction with an H-tone verb root.

(12)   Phrase-finally: Both tones survive and spread.

H	L	H
a̱	ya	se̱ɓent-a	> a̱-yá-[sé̱ɓé:nt-a	'work'
SM6	PROG

| | | se̱ɓent-el-an-a | > a̱-yá-[sé̱ɓént-él-a:n-a | 'work+appl+recip' |
| | | pʰe̱keletel-an-a | > a̱-yá-[pʰé̱ké̱lé̱tél-a:n-a | 'accompany+recip' |

'They are V…ing'

As in phrase-final forms, in phrase-medial position there is a shift of the initial H tone, then spreading of the next H tone to the usual penult location for phrase-medial forms.

(13)   Phrase-medially: Both tones survive.

```
H      L       H
a      tawu    seɓent-a        >    a-táwú-[séɓént-ís-a Sipho        'work+caus'
SM6    FUT
               seɓent-el-a     >    a-táwú-[séɓént-él-a Sipho        'work+appl'
       'They will V… Sipho'
```

4.4   TWO ADJACENT H TONES WITHIN THE PHWD

When the source of H tone combines morphemes from outside the MStem and from within the MStem (PhWd), one H tone appears to be deleted if the tones are adjacent, as in the previous examples, where both H tones were within the MStem.[4] However, the surviving H, instead of shifting to the antepenult, spreads to that position, so that the intervening syllables are also H-toned phrase-finally (compare (10)).

(14)   Phrase-finally: Tone spreads to the antepenult.

```
H      H       L
a      yi      natsʰ-ile           >    a-[yí-nátsʰ-i: le            'drink'
SM6    OM9
               natsʰ-is-is-ile     >    a-[yí-nátsʰ-ís-ís-i: le      'drink+intens'
       'They V…(pst) it'
```

Unlike in the phrase-final forms, there is no spreading phrase-medially: rather, there is shifting to the penultimate syllable. The tonal behaviour follows the same procedure as in the previous examples where there was one H tone contributed by the MStem (compare (11)).

(15)   Phrase-medially: Tone shifts to penult.

```
H      H       L
a      yi      ɬaɠul-a         >    a-[yi-ɬaɠúl-a kanyekanye        'weed'
SM6    OM9
               ɬaɠul-is-is-a   >    a-[yi-ɬaɠul-is-ís-akanyekanye 'weed+intens.'
       'They V…together'
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4   See Section 6 for an argument that the tone is not deleted, but fuses with the following tone phrase-finally.

This section has presented verb roots that are more than two syllables long. The generalisations on tone alignment observed may be summarised as follows:

(16)   Generalisations
* H tone moves rightwards, to the penult in phrase-medial forms and to the antepenult in phrase-final forms.
* Tone never moves leftward.
* In HLH sequences both Hs survive and there is shift of the first tone to the next syllable and spreading of the second tone to either the penult or the antepenult in phrase-medial and phrase-final forms respectively.
* If two Hs are adjacent, one will get deleted: the surviving tone either shifts or spreads to the penult or antepenult.
* When the source of at least one H tone is outside the Macrostem there is tone spread instead of tone shift, but only in phrase-final forms.

In the next section I discuss tone alignment on verb roots that are monosyllabic and disyllabic.

4.5   MONOSYLLABIC AND DISYLLABIC VERB ROOTS

One of the generalisations concerning tone movement in siSwati is that H tone moves rightwards, to the penult in phrase-medial forms and to the antepenult phrase-finally. An additional generalisation is that, in monosyllabic or disyllabic verb roots, rightward tone shift is blocked. The position of the surface tone depends on the source of the underlying tone; for example, in (17) and (18), the surface tones remain in their underlying positions, the initial syllable of the root, both in phrase-final and phrase-medial forms.

(17)   Phrase-finally

```
L      L      H
ni     ya     pʰ-a̱      >      ni-ya:-pʰ-á̱        'give'
SM2P   PROG
              ɓo̱n-a    >      ni-ya- ɓó̱: n-a    'see'
'You (pl.) are V…'
```

(18)   Phrase-medially

```
L      L      H
ni     tawu   pʰ-a̱      >      ni-tawu-pʰ-á̱ Sipho        'give'
SM2P   FUT
              ɓo̱n-a    >      ni-tawu- ɓó̱n-a Sipho    'see'
'You (pl.) will V… Sipho'
```

(19)   Phrase-finally

```
H      L      L
ɓa̱     ya     lʷ-a      >      ɓa̱-yá:-lʷ-a           'fight'
SM2    PROG
              natsʰ-a   >      ɓa̱-yá-na:tsʰ-a        'drink'
       'They are V…ing'
```

(20)   Phrase-medially

```
H      L      L
ɓa̱     to     lʷ-a      >      ɓa-tó-lʷ-a kanyekanye         'fight'
SM2    FUT
              natsʰ-a   >      ɓa̱-to-nátsʰ-a kanyekanye      'drink'
       'They will V… together'
```

Where there is deletion and shift in polysyllabic roots, monosyllabic and disyllabic forms, as in (21) and (22), delete the initial H tone while the following tone does not shift but remains in the underlying position.

(21)   Phrase-finally

```
L      L      H      H
ni     ya     yi̱     pʰ-a      >      ni-ya-[yi̱:-pʰ-á       'give'
SM2P   PROG   OM9
                     ɓon-a     >      ni-ya-[yi̱-ɓó̱: n-a    'see'
       'You (pl.) are V… it'
```

(22)   Phrase-medially

```
L      H      H
ni     yi̱     pʰ-a      >      ni-[yi̱-pʰ-á kanyekanye       'give'
SM2P   OM9
              ɓon-a     >      ni-[yi̱-ɓó̱n-a kanyekanye      'see'
```

   'You (pl.) V… it together'

In a HLH sequence, both H tones survive in polysyllabic roots and there is shift of the initial H while the second H spreads (see 12 and 13). In (23) though, we see a different pattern: in monosyllabic forms, although both tones survive, there is neither shift nor spread of tone. Nonetheless, in disyllabic forms, there is shift of the initial H tone but the second H does not spread.

(23)   Phrase-finally

```
H      L      H
a      ya     pʰ-a      >      á-ya:-[pʰ-á        'give'
SM6    PROG
              ɓon-a     >      a-yá-[ɓǫ́:n-a       'see'
       'They are V…ing'
```

(24)   Phrase-medially: Both tones survive and spread.

```
H      L      H
a      to     ɓon-a     >      a-tó-[ɓǫ́n-a Sipho    'see'
SM6    FUT
       'They will V… Sipho'
```

In polysyllabic stems, when two adjacent H tones are within the PhWd, there appears to be deletion and spread of the tone to the antepenult phrase-finally and shift instead of spreading in phrase-medial forms. However, in monosyllabic roots, there is neither deletion nor spread phrase-finally (see 25). In phrase-medial forms such as (26), there is deletion in monosyllabic forms but no spreading of tone; however, in disyllabic forms there is deletion of the initial H and shift of the second H.

(25)   Phrase-finally

```
H      H      L
a      yi     lʷ- ile   >      á-[yí-lʷ- i: le     'fight'
SM6    OM9
       'They V…(pst) it)'
```

(26)   Phrase-medially: Tone shifts to penult.

```
H      H      L
a      yi     lʷ-a      >      a-[yí-lʷ-a kanyekanye        'fight'
SM6    OM9
              natsʰ-a   >      a-[yi-nátsʰ-a kanyekanye     'drink'
       'They V…together'
```

5. ANALYSIS: AN ALIGNMENT APPROACH

I first present an analysis of tone in phrase-medial forms where an H tone is contributed by either the MStem or the PhWd and where rightward movement targets the penultimate syllable. The generalisation that tone moves rightwards

is accounted for by an alignment constraint, ALIGN-R (27), which requires that H tone be aligned with the right edge of the word.[5]

(27) ALIGN-R (H, PRWD): Every H tone should be aligned with the right edge of a Prosodic Word.

Since the target of tone is either the penult (phrase-medially) or the antepenult (phrase-finally), ALIGN-R will be assessed on a gradient to allow tone to be realised as close to the end of the word as possible. To account for the extratonality of the final syllable, I use the constraint NONFINALITY (28).

(28) NONFINALITY: Do not align H tone with the right edge of the Prosodic Word.

5.1   PHRASE-MEDIAL FORMS

5.1.1 One H tone in the input

In the following tableaux, the word that follows the verb phrase will not be included since it is irrelevant to the discussion (see example 7 for the whole phrase and gloss). /.../ will be used in place of that word to show that the form is non-final. I use underlining to show the location of underlying H, and an acute accent to show its surface placement. Square brackets indicate the MStem boundary.

NONFINALITY is ranked above ALIGN-R to optimise movement up to the penult of the verb phrase.

(29)   NONFINALITY >> ALIGN-R (see example (7))

/ ɓa̱-to- [natsʰ-is-an-a.../	NONFINALITY	ALIGN-R
a. ɓa̱-to-[natsʰ-is-an-á	*!	
b. ɓa̱-to- [natsʰ-ís-an-a		**!
c.☞ɓa̱-to- [natsʰ-is-án-a		*

We mentioned that tone needs to be aligned with the right edge; however, candidate (29a) illustrates that the final syllable cannot be a target. The high-ranking NONFINALITY rules the candidate out. In the optimal candidate, (29c), the tone has moved rightwards, but not to the final syllable; hence the

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5   Yip (2002) applies the concept of alignment constraints originally developed by McCarthy and Prince (1993a).

minimal violation of ALIGN-R. In (29b), there is extra violation of ALIGN-R, eliminating candidates where tone stops short of the penult.

Although candidate (29a) is ruled out by NONFINALITY, monosyllabic roots may realise an H tone on the final syllable, when it originates from this syllable, for example, /ni-tawu-pʰá/ 'you (pl.) will give'. In this word, there is a single H tone contributed by the verb root. Since movement is only rightwards, tone fails to shift to the predicted penultimate syllable. Leftward movement is blocked by the constraint ANCHOR-L (30) which prohibits leftward movement of the input tone.

(30) ANCHOR-L: Leftward movement of H tone is prohibited. (Adapted from McCarthy and Prince 1995).

Ranking ANCHOR-L above NONFINALITY allows tone to remain on the final syllable in monosyllabic roots. (31) presents a formal analysis of /ni-tawu-phá/ 'you (pl) will give…' and illustrates the dominance of ANCHOR-L over NONFINALITY.

(31)   ANCHOR-L >> NONFINALITY (see example (18))

/ni-tawu-pʰ-a̲…/	ANCHOR-L	NONFINALITY	ALIGN-R
a. ni-tawú-[pʰ-a̲	*!		*
b.☞ni-tawu-[pʰ-á̲		*	

Although candidate (31a) realises tone on the expected penultimate syllable, for phrase-medial forms, leftward shift violates ANCHOR-L. In candidate (31b) the tone remains in its underlying positions but survives with a minimal violation of NONFINALITY.

5.1.2 Adjacent H tones: Anti-Meeussen's rule applies

A sequence of two H tones is avoided by deletion of one of the tones, a process common in Bantu languages. The process whereby the second of the two tones deletes is known as Meeussen's Rule, as in Shona (S.10), /ndi-chá-te̲ng-es-a/ 'I will sell' (Myers 1997). The process whereby the first tone deletes is known as Anti-Meeussen's Rule. This is what happens in siSwati. According to Myers (1997), Rimi (F.32) also deletes the first H tone in a sequence. Deletion of one of the tones is one way of obeying the OCP, given below in (32), which ensures that there are no adjacent identical tones.

(32)   OCP: Adjacent H tones are prohibited (Myers 1997).

However, deletion violates the constraint *DISASSOCIATE in (33) (Yip 2002).

(33)   *DISASSOCIATE (*DISASSOC): No removal of association lines.

Since deletion of one of the tones is preferred to adjacent tones, in siSwati, the OCP must dominate *DISASSOC. This constraint ordering is illustrated by the tableau in example (34) for example (22) above.

(34)   OCP >> *DISASSOC

/ni-[yi̱-ɓo̱n-a…/	OCP	*DISASSOC
a. ni-[yí-ɓón-a	*!	
b.☞ni-[yi̱-ɓón-a		*

Candidate (34a) is the most faithful to the input since both tones are kept. However, this results in a violation of the OCP. Because *DISASSOC is ranked below the OCP, candidate (34b), which has deleted one of the tones is then chosen as the winner. Another candidate to consider is the one that applies Meeussen's Rule instead of Anti-Meeussen's Rule. This candidate would be ruled out by ALIGN-R because the remaining tone would be one more syllable away from the right. In (35), I include such a candidate with ALIGN-R added to the tableau. Observe that this candidate, though, does not give us a ranking relationship between ALIGN-R and the OCP. Later, I will present cases of forms which show that a violation of the OCP is worse than aligning all the tones with the right edge.

(35)   OCP >> ALIGN-R >> *DISASSOC

/ni-[yi̱-ɓo̱n-a…/	OCP	ALIGN-R	*DISASSOC
a. ni-[yí-ɓón-a	*!	***	
b. ni-[yí-ɓo̱n-a		**!	*
c.☞ni-[yi̱-ɓón-a		*	*

Candidates (35b, c) incur violations of the same constraints, except that candidate (35b) has more violations of ALIGN-R[6].

5.1.3 Two non-adjacent H tones

In a HLH sequence, we see a derived OCP violation, as in /a̱tóɓo̱na/ 'they will see'. I argue that this results from the pressure that tone should always move from its underlying source.

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[6]   Although candidate (35a) is ruled out by the OCP, it could also be ruled out by ALIGN-R: Every OCP violation incurs an extra ALIGN-R violation (unless one H is final).

Observations from the data show us that tone always moves at least one syllable to the right, as long as the result respects NONFINALITY. In her analysis of Nguni languages, Downing (1990) observed that there are two different types of tonal movement; one to the adjacent syllable and the other to either the penult or antepenultimate syllable. She referred to these movements as Local shift and Metrical shift, respectively. I propose that Downing's Metrical shift results from ALIGN-R, as in the previous section, while Local shift is accounted for by the constraint which I call TONEREJECTION (36), which requires that tone must move from its underlying source.

(36) TONEREJECTION: A tone in the output must not be associated to the TBU with which it is associated in the input.

However, in contrast to Downing's (1990) Local shift, which requires that the movement of tone should be within a specified domain, in TONEREJECTION, first, the tone must move off its original TBU, and secondly, and most crucially, it can move any distance. The form /a̱tóɓón-a/ with an underlying HLH sequence shows us that a violation of the OCP is preferred to leaving the tone in its underlying source. This motivates the ranking of TONEREJECTION above the OCP. Nonetheless, the second tone on /ɓo/ does not move. This suggests the dominance of NONFINALITY over TONEREJECTION.

(37)   NONFINALITY >> TONEREJECTION >> OCP (see example (24))

/a̱-to-[ɓon-a…/	NONFINALITY	TONEREJECTION	OCP	*DISASSOC
a. a̱-tó-[ɓo̱n-á	*!			**
b. á-to-[ɓón-a		**!		
c.☞a̱-tó-[ɓón-a		*	*	*

Candidate (37a) respects TONEREJECTION in that both tones shift. However, movement to the final syllable is prohibited in siSwati, hence the fatal violation of NONFINALITY by this candidate. Leaving both tones in their underlying positions results in two violations of the constraint TONEREJECTION (candidate 37b). The optimal candidate moves the first tone but not the second, hence the minimal violation of TONEREJECTION. (38) shows the constraint ranking so far.

(38) ANCHOR-L >> NONFINALITY >> TONEREJECTION >> OCP, ALIGN-R >> *DISASSOC

5.2   PHRASE-FINAL FORMS

In phrase-final forms, tone targets the antepenult instead of the penult. We already have a grammar that ensures rightward movement of tone. However,

this grammar favours a candidate that realises tone on the penult syllable over one that realises it on the antepenult. Since ALIGN-R is assessed in terms of a gradient, that candidate would have one violation of ALIGN-R while the correct output would have two. We therefore need a constraint that will account for the retraction of tone from the penult to the antepenult in these forms. Recall that the penultimate syllable is lengthened and stressed when words appear in phrase-final position (vowel lengthening is indicated by a colon after the vowel). To account for this generalisation, Downing (1990) argues for the constraint NOOVERLAP. Downing's NOOVERLAP suggests that tones may be grouped into tonal domains, which may in turn be classified as a type of prosodic constituent. Since stress also forms a prosodic constituent, these may not overlap. Cassimjee & Kisseberth (1998), on the other hand, use the constraint AVOID PROMINENCE. The understanding is that, because of the prominence of the penultimate syllable, it should be avoided by other prominent features like an H tone. Since I do not use tonal domains in my analysis, I adopt Cassimjee & Kisseberth's AVOID PROMINENCE (39), which is not necessarily specific to tonal domains.

(39) AVOID PROMINENCE (AVOIDPROM): High tone may not be realised on a prominent syllable (adapted from Cassimjee & Kisseberth (1998)).

The effect of AVOID PROMINENCE is that tone is realised further away from the right. This constraint should therefore be ranked above ALIGN-R. (40) illustrates.

5.2.1 One H tone in the input

(40)   AVOIDPROM >> ALIGN-R (see example (6))

/ɓa-ya-[ɬaɠu-is-an-a/	AVOIDPROM	ALIGN-R
a. ɓa̱-ya-[ɬaɠul-is-á:n-a	*!	*
b.☞ɓa̱-ya-[ɬaɠul-ís-a:n-a		**

Ranking AVOIDPROM above ALIGN-R ensures that (40b) with two violations of ALIGN-R is chosen as the optimal candidate over (40a) with only one violation.

In disyllabic roots, tone may originate from the prominent syllable and remain there, even though AVOIDPROM prohibits tone on this syllable. The tone moves neither to the left or right. We mentioned that leftward movement is prohibited by the undominated ANCHOR-L, which must therefore dominate AVOIDPROM. The failure to move rightwards suggests that AVOIDPROM is also dominated by NONFINALITY.

(41)   NONFINALITY >> AVOIDPROM (see example (17))

/niya[ɓon-a/	ANCHOR-L	NONFINALITY	AVOIDPROM	ALIGN-R
a. niyá[ɓo̠:n-a	*!			**
b. niya[ɓo̠:n-á		*!		
c. ☞niya[ɓó̠:n-a			*	*

Movement to the expected antepenult violates the high-ranked ANCHOR-L; hence, (41a) is ruled out, while (41b) incurs a fatal violation of the equally high-ranking NONFINALITY.

If tone originates from the antepenult, the expectation is that it would remain on that syllable. However, because of TONEREJECTION, there is still movement to the adjacent syllable; (ɓaya:lʷa → ɓayá:lʷa), creating a violation of AVOIDPROM. The form /ɓayá:lʷa/ suggests that TONEREJECTION should be ranked above AVOIDPROM. (42) formalises the analysis.

(42)   TONEREJECTION >> AVOIDPROM (see example (19))

/ɓa̠-ya:-[lʷ -a/	TONEREJECTION	AVOIDPROM	ALIGN-R
a. ɓá̠-ya:-[lʷ -a	*!		**
b.☞ɓa̠-yá:-[lʷ -a		*	*

5.2.2 Two non-adjacent H tones

We have observed that in a HLH sequence, for example /a̠tóɓó̠na…/, the pressure to move creates an OCP violation, motivating a ranking of TONEREJECTION above the OCP. However, if the second tone is from a monosyllabic root with no suffixes, the initial tone remains in its underlying position; (/áya:pʰá/ and not */ayá:pʰá/), respecting AVOIDPROM at the expense of TONEREJECTION. We have also seen from /ɓayá:lʷa/ that TONEREJECTION cannot be below AVOIDPROM, and from /á̠toɓó̠n-a/ that TONEREJECTION is above the OCP. Seemingly, /áya:pʰá/ neutralises the ranking of TONEREJECTION above AVOIDPROM and renders these constraints equal, leaving the decision to the OCP. (Note that equal ranking also works for (42), since ALIGN-R decides things.)

(43)   TONEREJECTION, AVOIDPROM >> OCP (see example (23))

/a̠-ya-[pʰ-a̠/	NON-FINALITY	TONE-REJECTION	AVOID-PROM	OCP	ALIGN-R
a. a̠-yá:-[pʰ-á	*		*	*!	*
b. ☞ á̠-ya:-[pʰ-á	*	*			**

5.2.3 Adjacent tones: Anti-Meeussen's Rule applies

Recall that in phrase-medial forms an OCP violation is prevented by the application of Anti-Meeussen's Rule. This rule applies in phrase-final forms as well, but only when both H tones are contributed by the MStem. (44) illustrates the derivation of /ni-ya-[yi̠-se̠ɓént-e:la/ 'you (pl.) work for it'. The same constraints and ranking will account for these forms.

(44)   MStem: Application of Anti-Meeussen's Rule (see example (10))

/ni-ya-[yi̠-se̠ɓent-el]a/	OCP	*DISASSOC
a. ni-ya-[yí̠-sé̠ɓent-e:-la]	*!	
b.☞ni-ya-[yi̠-se̠ɓént-e:l-a]		*

Another possible candidate is one that moves the second tone away from the first, in order to avoid an OCP violation. This candidate would be ruled out by TONEREJECTION, since it is ranked above the OCP. When one of the tones is contributed by a morpheme outside the MStem (indicated by square brackets) Anti-Meeussen's Rule does not apply, but this is true only phrase-finally, though. Instead, in these forms, there is fusion and tone spread to the antepenult, for example, /ɓa̠-[yí-nátsʰ-ile]/ 'They drank it'.

5.3   EVIDENCE FOR FUSION IN THE PHWD

Before I present an analysis of tone in the PhWd, I first provide evidence for the claim that fusion, instead of deletion of tones, applies in the PhWd. This pattern is seen when one of the H tones is outside the MStem. Evidence for fusion comes from verb phrases with a trisyllabic verb stem (a stem including a verb root plus suffixes). First, consider the word /ni-ya-[yi̠-se̠ɓé:nta]/ (example (10)), where both H tones are contributed by the MStem in square brackets. The tone from /yi̠/ deletes, while the second tone from the root-initial syllable /se̠/ moves to the penultimate syllable: Anti-Meeussen's Rule applies. We already know that, in phrase-final forms, tone avoids the penultimate syllable and that AVOIDPROM prevents it from being realised on this syllable. However, in /ni-ya-[yi̠-se̠ɓé:nta]/, tone is realised on this syllable. This, as I have already argued, results from the constraint TONEREJECTION. This example clearly shows that the surviving tone is the one from /se̠/ not from /yi̠/, because the tone from /yi̠/ would have moved onto the antepenult, not the penult. This is evidence that siSwati uses Anti-Meeussen's Rule to remove OCP violations.

Next, consider the word /ɓa̠-[yí-nátsʰ-í:le]ₘₛ/ₚₕ𝓌𝒹, where, as in /ni-ya-[yi̠-se̠ɓé:nta]/, there are two adjacent tones. The difference is that in this example one of the H tones is outside the MStem. Application of Anti-Meeussen's Rule

to this form would result in a deletion of the tone on /ɓa̱/ while the tone from /yi̱/ would shift to /na/ to obey the constraint TONEREJECTION. However, this is not the case, instead /yi̱/ is still realised with an H tone. I propose that the tones on /ɓa̱/ and /yi̱/ fuse, and, because of the constraint TONEREJECTION, spreading starts from the second syllable. Fusion of input tones to form one output tone is a violation of UNIFORMITY (45), which requires correspondence to be one to one.

(45) UNIFORMITY: Output tones must not have multiple correspondents in the input.

Fusion, like Anti-Meeussen's Rule, is another way of obeying the OCP; hence the constraint UNIFORMITY should be dominated by the OCP. In addition to fusion, there is spreading of tone to adjacent syllables in these forms. Spreading results from the requirement that TBUs be specified for tone. SPECIFY (46) accounts for the spreading in the PhWd.

(46) SPECIFY: A TBU must be associated with tone (Yip 2002).

However, specifying all the TBU's with tone, that is those which did not have any underlyingly, violates a faithfulness constraint *ASSOCIATE (47) which prohibits new association lines.

(47)   *ASSOCIATE (*ASSOC): No insertion of association lines (Yip 2002).

To account for spreading in the PhWd, SPECIFY should dominate UNIFORMITY and *ASSOC.

(48)   PhWd: Fusion and spread: SPECIFY >> UNIFORMITY

/ɓa̱-yi̱-naʦʰ -ile/ | | H₁ H₂	SPECIFY	UNIFORMITY	*ASSOC

a. ɓa̱-[yi̱-náʦʰ -ile]
       |
      H₂
	****!		*

b. ☞ɓa̱-[yí-náʦʰ -ile]
      |╱
     H₁,₂
	***	*	**

Candidate (48a) deletes the first tone (Anti-Meeussen's Rule) and the second shifts to the antepenult. This results in a smaller number of syllables specified for tone; hence the fatal violation of SPECIFY. The optimal candidate, on the other hand, incurs fewer violations of this constraint, since fusion is accompanied by spreading of the tone to other syllables. The winning candidate

has, in addition, more violations of *ASSOC, comparatively. The candidates do not give us a ranking argument for the constraints UNIFORMITY and *ASSOC.

The above ranking and constraints do account for the preference of fusion to deletion in the PhWd. However, in the MStem, where the application of Anti-Meeussen's Rule is preferred to fusion, a candidate like the ill-formed (48a) would be the one favoured.

Recall Myers's (1997) observation of tonal behaviour in Shona. He observed that, in this language, the domain of Meeussen's Rule was the PhWd while the domain of fusion was the MStem. SiSwati behaves in just the opposite way, where Anti-Meeussen's Rule applies in the MStem and fusion in the PhWd. Myers assumes that phonological domains are different in morphologically-defined domains. Like McCarthy and Prince (1993), he further assumes that each domain has an independent constraint ranking. For siSwati, this would be UNIFORMITY >> SPECIFY for the MStem, but SPECIFY >> UNIFORMITY for the PhWd. In my analysis, though, I will depart from Myers, and show that the two processes result from the same grammar. The idea is that an equivalent of root-faithfulness constraints results in the lack of fusion in the MStem. Generally speaking, faithfulness constraints require a lexical form to remain unchanged at the surface. McCarthy and Prince (1995a) have proposed that faithfulness requirements are more strictly imposed within roots than in other types of morphemes, such as affixes. This leads to the conclusion that there are distinct faithfulness constraints for roots and affixes. To capture this linguistic tendency in OT, root-faithfulness constraints are ranked above the general versions of these constraints. In siSwati, the contrast is not so much Root-Affix as Stem/Affix, assuming that Myers' MStem is a type of stem.

Following from the above argument about the general status of roots cross-linguistically, I argue that, in the MStem, just as in roots, there is a need to preserve as much input material as possible. I further suggest that there is a positional faithfulness constraint that is specific to the MStem, UNIFORMITY-MACROSTEM (49), ranked above both the markedness constraint (SPECIFY) and the general faithfulness constraint, (UNIFORMITY), and that this constraint ensures that there is no fusion of tone in the MStem, while it is permitted in the PhWd.

(49) UNIFORMITY-MACROSTEM (UNIFORMITY-$_{MSTEM}$): Output tones must not have multiple correspondents in the input MStem.

The suggested ranking will account for the lack of fusion and spreading in the MStem (see (50)), while allowing it in the PhWd (see (51)). The MStem domain is marked by square brackets.

(50)   MStem: No fusion- UNIFORMITY-_{MSTEM} >> SPECIFY

/ni-ya-[yi̱-seɓenta]/ | | H₁ H₂	UNIFORMITY-MSTEM	SPECIFY	UNIFORMITY	*ASSOC
a. ni-ya-[yi̱-sέɓέ:nta] |╱ H₁,₂	*!	****	*	**
b. ☞ni-ya-[yi̱-se̱ɓέ:nta] | H₂		*****		*

Candidate (50a), with fusion of the two input H tones into one, violates UNIFORMITY-_{MSTEM}.

The same ranking allows both fusion and tone spread in the PhWd. UNIFORMITY-_{MSTEM} has no influence on these forms.

(51)   PhWd: Fusion and spread- SPECIFY >> UNIFORMITY

/ɓa̱-[yi̱-natsʰ-ile]/ | | H₁ H₂	UNIFORMITY-MSTEM	SPECIFY	UNIFORMITY	*ASSOC
a. ɓa̱-[yi̱-nátsʰ-ile] | H₂		****!		*
b. ☞ ɓa̱-[yí-nátsʰ -ile] |╱ H₁,₂		***	*	**

Tableaux (50) and (51) illustrate that independent constraint rankings for the MStem and PhWd are not necessary, at least not for siSwati, as long as the specific faithfulness constraints are ranked above the general faithfulness constraints. (52) shows the ranking for these constraints.

(52)   UNIFORMITY-_{MSTEM} >> SPECIFY >> UNIFORMITY

The grammar that I have developed for siSwati, and the arguments that I put forward earlier, point towards fusion of tone in the PhWd. However, there is no phonetic evidence to support this claim. Experimental work is therefore required to confirm or dispute the claim that there is fusion in the PhWd. It has been suggested that a sequence of tones that result from spreading is realised with the same pitch: whereas, if the tones are separate they are realised with a downstep in between the two H's (Odden 1995, Myers 1997).

6. SUMMARY

In this paper, I have demonstrated how different factors influence tone shift and tone spread in siSwati, namely the phrase-final or phrase-medial position of a word in an utterance; the number of tones in a particular word; the sequence of tones, whether the tones are adjacent, as in HH or non-adjacent as in HLH; and, finally, the morphological domain of underlying tone.

In the OT analysis presented, I have illustrated how the interaction of different constraints could account for the behaviour of tone in siSwati. In addition, and most crucially, I have demonstrated how the ALIGN-R constraint, just as in the passive ensured the movement of tone to the right edge of the word.

The behaviour of tone confirmed not only the long-distance effects observed in the language, but also the effect of ALIGN-R. The results of the experiment confirmed the generalisations made about the behaviour of tone in siSwati. It was concluded from the data and analyses that the surface position of tone was influenced by different and unrelated factors: a) the position of a word in an utterance; whether it was phrase-final or phrase-medial, b) the number of tones in a particular word, c) the sequence of tones, whether adjacent, as in HH or non-adjacent as in HLH, and, most importantly, d) if the tones are adjacent, the morphological domain of the tones matters: whether it is the PhWd or the MStem. The results supported Myers' observation that the behaviour of the surface tone depended on the domain of morphemes that contributed tone. For example, spreading was shown to be associated with tone that was contributed by the PhWd while shifting was common in words whose tone was contributed by the MStem.

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